



Intel Powers Gaming

How the Pentium® 4 processor is changing the face of gaming

Why does the largest chip maker in the world care about games? Simply put, games matter because they are the one of the key areas of software where processing power actually matters.

Application speed for packages such as word processing or spreadsheets is rarely an issue. No one ever upgraded their PC because it couldn't keep up with their typing. Around 60 per cent of PC users play games, however; good news for Intel and the games industry alike.

To reverse the question, does Intel® matter to the games industry? With the company's new found enthusiasm for interactive entertainment, there are plenty of reasons why it should. For developers, Intel offers its developer support and early access programs. These help developers to realise their games' potential by ensuring they are optimised to take full advantage of Intel's processors.

Co-marketing deals with publishers such as 'Infogrames, 'EA and 'Lego will help grow the PC gaming market, as will Intel's sponsorship of LAN parties and the Cyberathlete Professional League. While at the sharp end of the industry, gamers running the Pentium® 4 processor have the assurance they are getting the best gaming experience for their money.

Intel, welcome back to the game.

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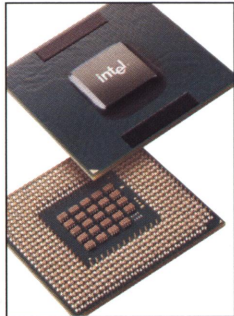
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Power behind the processor

Currently rated at 2.4GHz and rising fast, the Intel® Pentium® 4 processor offers the highest performance desktop technology, so what's the secret behind its grunt?



Proving its versatility, the Pentium 4 processor also provides sparkling low power performance in the mobile PC space

To be in the business of creating computer chips is to be in the business of marrying the seemingly impossible with reality on a regular basis. Inconceivable numbers and miniscule scales are thrown around with abandon, only to be trumped by even more inconceivable numbers and more miniscule scales the following year. But no company in the semiconductor industry is praised for keeping pace with Moore's Law, only criticised for falling behind its demanding pace.

Moore's law

In 1965, three years before he co-founded Intel, **Gordon Moore** predicted the number of transistors that would fit on a silicon chip would double each year for the next decade. Ten years later, he adjusted the cycle to 24 months. It was only in the late 1980s, another Intel executive pointed out the doubling was occurring every 18 months – the period of time Moore's Law is now taken to refer to. "It was not intended to be a precise prediction at all," recalls Dr Moore. "Only a guiding idea that integrated circuits were going to change the entire economics of the electronics industry."

No company in the semiconductor industry is praised for keeping pace with Moore's Law, only criticised for falling behind its demanding pace



In a chip fabrication plant, clean air flows continuously from every pore of the ceiling and through the holes in the floor. The entire volume of air in the clean room is replaced several times every minute

But such is the speed of the industry, to many, the workings of the modern computer are more akin to magic than the logical outworking of micro-electronics and industrial design. After all, what does it mean that the Pentium® 4 processor, a small piece of silicon, millimetres square, has 55 million electrical logic gates etched onto it – particularly when one of those transistors is a thousand times thinner than the average human hair? Yet in a very real sense, this is technology which enables the workings of everyday life.

Supercharged performance

With the Pentium 4 processor, Intel offers higher performance desktop processing than ever before. The processor itself is built using the semiconductor industry's most advanced manufacturing process, Intel's 0.13-micron fabrication process, with highly-efficient copper interconnects. This technology allows the size of the processor to be reduced by over 30 per cent, while increasing its on-board memory.

Launched at clock speed of 1.3GHz, the Pentium 4 processor has since been uprated to 2.4GHz, offering almost twice the power of its earliest incarnation. The performance of a processor is measured by the time it

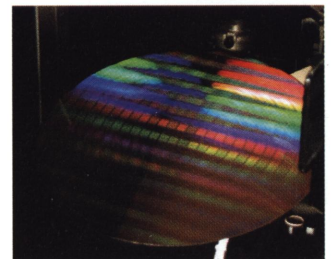


including a faster internal system bus, and more efficient use of caches and the processor's execution units.

Simple instructions

Another neat trick used by the Pentium 4 processor is to reduce the number of instructions that it takes to execute a task by performing the same calculation on multiple blocks of data at the same time. Known as Single Instruction Multiple Data (SIMD), it was first introduced on the Pentium processor using MMX™ technology for 64bit integer instructions. This became known as Streaming SIMD Extensions (SSE) for 128bit floating point instructions on the Pentium III® processor. The Pentium 4 processor uses SSE2, which implements 144 new SIMD instructions.

The Pentium 4 processor has also proved its potential in the laptop space. The mobile Intel Pentium 4 processor-M, rated at 1.7GHz is the fastest mobile processor available. Operating at a low voltage, the Intel® Enhanced Intel SpeedStep™ technology also ensure that a minimum amount of power is used when running applications.



The Pentium 4 processor is created using Intel's state-of-the-art 0.13 micron production process

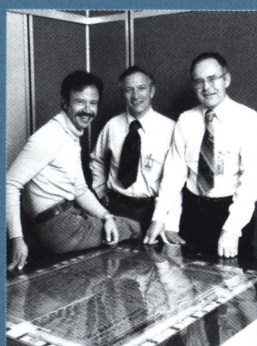
The essential link

Intel figures

Number of employees: 80,000
Revenues: \$26.5 Billion (2001)
Products and services: over 450
Fortune 500 ranking: 41
Worldwide offices: 45

It came from Mountain View

It was July 18, 1968 when Robert Noyce and Gordon Moore started the Intel Corporation in Mountain View, CA. Back then, Intel's goal was to create a semiconductor alternative to magnetic core memory. Its first product was the 1103, a dynamic random access memory (DRAM) chip. Total revenue over its first financial year was \$2,672. Meanwhile, a Japanese firm, "Busicom, contracted Intel to create 12 chips for a desktop printing calculator. The result however, was a single general-purpose device, the 4004 microprocessor, announced in 1971. Less than a year later, Intel created the 16bit 8008. Its successor, the 8088, was used in IBM's first PC. Next came the 32bit 386, which was 100 times more powerful than the 4004. It remains the only chip able to run DOS and UNIX programs simultaneously. It was also the precursor to the Pentium family of processors.



Ten years after Intel was founded, Andy Grove, Robert Noyce and Gordon Moore pose for the camera

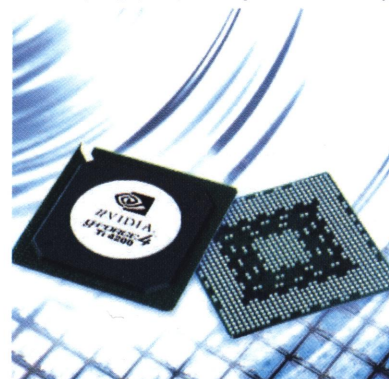
The secret of a superfast PC is all in the balance between the CPU and the graphics card

The explosion of powerful graphics processing units (GPUs) in recent years has thrown the purpose of a powerful CPU into sharp relief. "If I've got a monster graphics card in my system with 64Mb or even 128Mb of RAM, why have a top-of-the-range CPU as well?" is the oft-heard cry from gamers. This sort of thinking displays a complete misunderstanding of how the different components of a PC interact in order to handle a cutting edge computer game however.

As its name suggests, a graphics card deals with the graphical elements that make up a game scene, such as the textures, the geometry and the lighting. The CPU, on the other hand, handles the core data which drives the scene. This includes facets such as the interactions between objects – the collision detection and the physics modelling – and the artificial intelligence of characters. This information must first be processed, before being sent out to the graphics card, which then draws the scene frame. For each frame, the process is repeated. Clearly, to get the best experience, a gamer should ensure the performance levels of their CPU, GPU and the bus between them are properly balanced. Simply put, a powerful GPU with an old CPU is a waste of money.

"The Intel® Pentium® 4 processor introduces many exciting capabilities for increasing system throughput," explains Dan Vivoli, executive vice president of marketing at nVidia. "Working with Intel to optimise our GPUs for the Pentium 4 processor gives us the

nVidia's close working relationship with Intel has enabled it to develop its graphics processing units more efficiently



"If I've got a monster graphics card in my system, why have a top-of-the-range CPU as well?" is the oft-heard cry from gamers

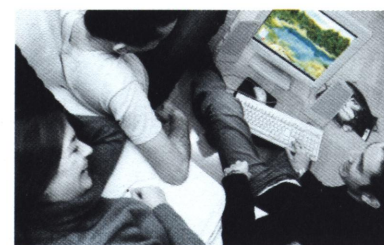
necessary insight to create unique techniques for efficiently moving complex images through its architecture." The NetBurst™ micro-architecture and enhanced system bandwidth of the Intel Pentium 4 processor is particularly important in this respect. It ensures the maximum amount of data throughput so a gamer's graphics card is always efficient, waiting for information to process.

XP experience

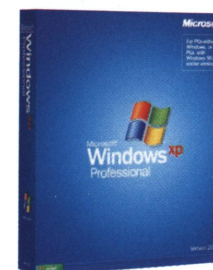
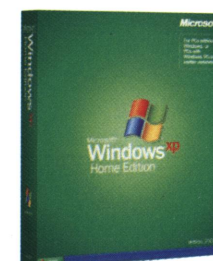
The Pentium 4 processor takes advantage of optimisations written into Microsoft's Windows XP operating system too. Most importantly for gamers, Microsoft's DirectX 8 3D libraries often use the Pentium 4 processors SSE2 instruction set. For example, the Direct3DX processor specific graphics pipeline library has an SSE2 optimised library for faster rendering. Other optimisations include those within the Windows XP TCP/IP stack. This manages

the flow of information between a PC and networks, including the Internet.

Using this has a marked improvement in download times, particularly for broadband Internet users. In addition, the Pentium 4 processor SSE2 instruction set enables Windows XP to use a PC's system memory more efficiently by eliminating unnecessary calculations and providing more problem checking information.



Microsoft's DirectX 8 3D libraries make full use of the Pentium 4 processor's SSE2 instruction set



To get the maximum game-playing potential out of a PC, you'll want to balance a fast Pentium 4 processor with a fast graphics card. Running Windows XP also allows a game's DirectX libraries to take advantage of the latest optimisations

Pushing the envelope

There's only one way to remain at the forefront of processor performance and that's hardcore R&D



Intel's bumpless build-up layer technology grows a processor's package around it, resulting in a thinner, more robust structure

To keep up with the relentless pace predicted by Moore's Law, Intel spends billions of dollars a year on research and development.

Recent advances in chip technology have covered a range of specialist fields as varied as transistor structure, processor packaging and materials.

Key among these is what Intel is calling its TeraHertz transistor, which will be able to switch on and off more than one trillion times per second. Prior to this, Intel had already developed a 15 nanometre transistor (a nanometre is a billionth of a metre), which will enable single chips to carry up to one billion transistors by the second half of this decade. But as transistors become smaller and, in turn, more are packed onto each silicon chip, so environmental issues such as heat generation, electrical current leakage and power consumption become fundamental barriers to progress. Intel is focusing on two ways around the problem.

One involves a new transistor, called a depleted substrate transistor. This is combined with a new material, a high k gate dielectric. Together, they will help reduce current leakage and power consumption. "Our goal is to overcome these barriers and produce chips that have 25 times the number of transistors of today's microprocessors at ten times the speed with no



The heart of 'Macromedia's move to Shockwave 3D in Director 8.5 was provided by Intel Labs' streaming renderer

"Our goal is to produce chips that have 25 times the number of transistors, at ten times the speed with no increase in power consumption"

increase in power consumption," says **Gerald Marcyk**, director of components research at Intel Labs.

The TeraHertz transistor will, in time, enable powerful new applications such as realtime voice and face recognition, computing without keyboards, and smaller computing devices with higher performance and improved battery life.



Means of production

Another area Intel concentrates on is the manufacturing process required to fabricate its silicon chips. One breakthrough is the Bumpless Build-Up Layer (BBUL) technology. Currently, a processor die and the packaging which houses it and supplies it with electricity, are manufactured separately. They are then bonded together, with tiny balls of solder called bumps, which act as electrical and mechanical connections.

The BBUL approach does away with bumps entirely, as the package is grown around the silicon. High-speed copper connections are used to connect the die to the different layers of the package. This means the finished processors will be thinner, more mechanically robust and consume less power, despite having much higher performances. Using BBUL packaging, Intel hopes to create complex multi-chip processors and simple system-on-a-package processors as well.

Intel is also heavily involved in lithography, the process of printing onto silicon wafers. It leads a consortium of semiconductor companies, which have formed a company to develop a technology called Extreme UltraViolet (EUV) lithography. It's hoped this will enable the minimum size of an individual printed line to drop from the current limit of 90 nanometres to under 50nm by 2005.

Intel connected

As well as driving forward the design of processors, Intel is also heavily involved in ensuring data travels quickly between the PC's various components, the CPU and other peripherals. Back in 1993, it developed the Peripheral Components Interface (PCI) expansion bus to support data-intensive peripherals. Intel continues to be involved in this technology with the ongoing development of the Third Generation Input/Output (3GIO) technology.

Intel introduced the original specification for Advanced Graphics Port (AGP) in 1996. This increased the throughput of PC systems by offloading graphics data onto a dedicated bus between a system's CPU and its graphics card. AGP specification version 3.0, which defines the working of AGP8X technology, was released by Intel in 2001. Also conceived by Intel in 1996 was the Universal Serial Bus (USB) specification for plug-and-play devices such as digital cameras and MP3 players. A co-founder of the USB Implementers Forum, Intel continues to provide leadership in the development of the forthcoming USB 2.0 technology.

In addition, Intel has been one of the main drivers behind the Serial ATA (S-ATA) disk-interface technology to replace parallel ATA to connect hard disks, DVD and CD-R/Ws and PC motherboards. The Serial ATA 1.0 specification was released in August 2001, while the formation of the Serial ATA II working group was announced at the Intel Developer Forum in Spring 2002.



More than silicon

Hardware isn't any use without software: it's a good thing Intel does both

Name: Dan Snyder

Position: marketing manager, Consumer Solutions Group, Intel Europe

"Intel is strongly committed to the game development community. We're executing a continuous technology ramp in our processors and with our new TeraHertz technology we have shown a clear path to a billion transistors on chip and 10-20+ GHz by 2007. On a day-to-day working relationship basis, we provide something for every developer. Today's two-man outfit could be tomorrow's megahit, and we have seen this happen time and time again.

"Once we have supported and enabled the game developers to create cool new games optimised for our latest CPUs, the next step is promoting these titles and spreading the good news about the benefits to the consumer. This is where the Intel marketing machine takes over.

"Our group's role is to feed this machine continuously with cool content. Intel spends hundreds of millions of dollars every year on advertising alone, and we have placed optimised titles into television, Web and print adverts. We're also starting some major joint promotions and co-branding with some of the gaming community's biggest publishers.

"We want the game development community to perceive Intel as a must-have technology partner. We are constantly fine-tuning our programs for developers based on real world results and feedback. We are really excited about the future of gaming on the PC and want to make sure the next generations of games look and feel as exciting as possible."



WITH **intel** **Optimizers**
INTERNET 3D GRAPHICS

macromedia
DIRECTOR 8.5
SHOCKWAVE STUDIO

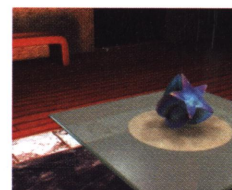
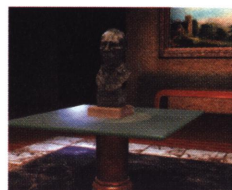
Research at Intel Labs isn't just about microscopic material manipulation and esoteric chip fabrication processes.

Some of the work of the 6,000 plus researchers also focuses on practical software design and development. One notable example is the 3D authoring abilities of *Macromedia's Director 8.5 Shockwave Studio.

Created to bring 3D graphics to the Internet, Intel Labs developed the package's sophisticated streaming 3D engine. Because of the limitations of the medium, a vital element was powerful compression technology, implemented using multi-resolution meshes and subdivisional surfaces. This lets developers create high level 3D models, which can be downgraded to a level compatible with the host PC they are being streamed to. Instruction sets streamed with the models can then be used to increase the model's detail when it's been downloaded. Other features include support for particle effects, realtime physics modelling and a software renderer for playback on PCs without 3D hardware. The engine obviously takes advantage of the full range of optimisations when running on the Intel® Pentium® 4 processor too.

The push towards photo-realistic 3D graphics is another area in which Intel Labs is working. Its Light Field Mapping (LFM) technology simulates the interaction between light and the surfaces of 3D objects. This is one of the key aspects in making a virtual scene appear more real. High-end film special effects can only be accomplished this via complex raytracing processing, which typically takes hours to render one frame.

The LFM method approximates the radiance of light fields by breaking an object's surface down into small primitives and then calculating the light field for each of these surfaces at a lower level. This is particularly applicable to computer games, as the resulting light field is compact enough to be directly rendered by a graphics cards in realtime. The light field can also be further compressed using standard techniques to create an extremely small data, set



Intel's Light Field Mapping technique gives developers the opportunity to create more realistic three-dimensional scenes for realtime applications, such as games

up to a thousand time smaller than the uncompressed version.

"The big challenge for the 3D graphics industry is how to bring the realism we know we are capable of delivering," says **Radek**

Grzeszczuk, senior research scientist with Intel's Microprocessor Research Labs. "The combination of a fast and simple rendering routine, small data sets and ease of content creation features in LFM will help bring more realism to computer graphics without sacrificing interactivity." Intel expects to see initial diffusion of LFM in about 18 months, with broader diffusion within two years.

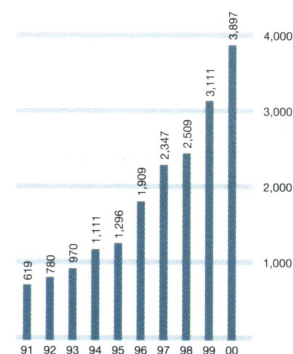
Here's looking at you

Computer vision has long been a staple of science fiction, perhaps most notably in Arthur C Clarke's '2001'. A recent advance by Intel's Software Development Centre in Nizhny Novgorod, Russia, has witnessed the release of

software enabling computers to recognise depth. Currently, computer vision applications recognise scenes as single flat colour fields. The new stereoscopic code will enable them to distinguish individual objects using depth information. It has been released as part of the open source computer vision library, OpenCV 2.1.

Intel dollars towards R&D

Dollars in millions, excluding purchased in-process R&D



Name: Hits Naik

Position: strategic marketing manager, Intel Europe

"Content is king - this is the mantra for developers and publishers. Intel works hard to drive innovation in new content through technology advancement and ensuring consumers see the benefits of such innovations through strong marketing. Intel is working with major brand-leading companies such as 'Infogrames, 'Lego and 'Electronic Arts to grow the games market to new audiences. An example is Intel's sponsorship of the Gaming Academy at the latest Legoland Germany Park.

"For major publishers, PC software sales form a key foundation of their profits, which maintain shareholder value. In a world of multiformat publishing, where console platforms come and go during each generational change, the PC is the only platform which continues to drive technological change without compromising publishers' revenue streams."



Strength in numbers

Everyone needs an occasional helping hand,
and that's why Intel® Developer Services exists

Name: Alex Klimovitski
Position: senior software application engineer, Intel Tools & Technologies Europe
"Modern PCs can play games blazingly fast, but they can also do more, if that game asks them to. This is the point of game optimisation. Landscapes can be more detailed, and characters can look and move smoother when developers utilise the features of the new CPUs.

"Intel's software tools allow game developers to effectively utilise the power of the Intel® Pentium® 4 processor. Along with its industry-leading working frequencies, larger caches, and faster memory interface, the Pentium 4 processor features the SSE2 special performance instructions. Other tools include the Intel® VTune™ Performance Analyser, which provides a clear picture of how well the code runs on a processor. For the users, this means better looking and more realistically behaving games."



Power is nothing without control; that's where Intel® Developer Services comes into play; to ensure software developers are making full use of the company's processors. A one-stop resource for developers (www.intel.com/ids), it provides access to white papers, case studies, online training and e-tutorials as well as code samples. Other non-technical areas covered include business development and marketing programs. Membership is free.

Another part of package is Intel's Early Access Program (www.intel.com/ids/eap). This is a comprehensive Web-based resource which helps developers take advantage of the power of Intel's cutting edge processors. Most relevant for game developers is the Early Access Program for the Intel® Pentium® 4 processor family.

Hardware and software tools are provided to aim optimisation, including a pre-release, next-generation 32bit processor software development vehicle, and Intel compilers, performance libraries and the Intel® VTune™ performance analyser. This software tool allows developers to see how efficiently code is being run on either an event-based or time-based sampling method. The results are displayed graphically for easy analysis, letting users quickly see how performance can be increased. In certain cases, the tuning assistant can also suggest code improvements and point out performance bottlenecks.

"This is the only code profiler and optimiser that I would consider for realtime high performance game applications," says Westwood Studios' **Robin Keir** in a VTune testimonial. "It has a negligible impact on runtime performance, which is critical to productive programming."

Kevin 'Zaph' Burfitt, at Beam Software agrees. "I need to get the entire game to run in 33ms per frame – that's AI, physics, 3D, everything. The VTune analyser enables me to efficiently track down the areas of the game that will influence the performance. Using the call



One benefit of Intel's Early Access Program is the chance to get applications on Intel's stand at events such as the Game Developers Conference. Intel also holds events such as the Intel Developers Forum

graph feature, combined with the timing analysis, I was able to track down a logic error that was causing an internal library function to eat up 10 ms per frame—an eternity in game time. The ability to watch inside thirdparty DLLs has enabled me to optimise our usage of those DLLs."

A side benefit of the EAP is a 20–25 per cent discount on Pentium 4 processor workstations from a variety of PC manufacturers, and access to thirdparty prerelease software and tools.

Once a project is finished, Intel also offers EAP members joint appearances at selected industry events and trade shows. For example, Intel had one of the biggest stands at this year's Game Developer Conference in San Jose. Companies as varied as network middleware

Name: Tasos Kaiafas
Position: chief gaming strategist, Intel Worldwide

"The crux of Intel's strategy in gaming is that things happen on the PC first. Although Intel already provides gamers with the world's fastest microprocessors, we also want to step up as a game technology leader by embracing and assisting companies with innovative technologies and products that enhance the PC game experience.

"Without a doubt, online gaming is here today and will only get better. PC gamers can expect to have many more choices for subscription-based massively multiplayer online games in the next couple of years, as well as streaming games and games-on-demand for those with a broadband connection. We feel that voice-in games, for chatting and for inputting commands, is another area that will make the game experience better. On the horizon, we see advanced physics and AI becoming the standard in PC games first, which will go a long way in enhancing the realism of the game environment. Further out, we're looking at innovations in user interface and input devices."



provider, "Quazal, game developer "Relic and AI vendor "BioGraphic all displayed their technology on the Intel booth.

Intel also produces an annual developer solutions catalogue, listing all the companies it is working with, and a Developer Solution CD which is distributed to thousands of users several times a year. Promotion of applications through Intel's end user sales force is another possibility.



Intel's Early Access Program is an essential Web-based resource for developers

Intel®
developer
services

Intel inside gaming

*Republic: The Revolution

Publisher: *Eidos Developer: *Elixir Studios Origin: UK



One of the most eagerly awaited PC games of the year, *Republic: The Revolution* is one of a new wave of games that put the ever increasing power of Intel processors to full use in order to revolutionise gameplay. It features both cutting-edge artificial intelligence, which scales up to a million agents, and Totality, one of the most advanced rendering engine ever seen. Key among *Republic's* towering achievements is the creation of vast 3D cities.

"The Pentium® 4 processor's SSE2 instructions allow the processing and type-converting of multiple data portions in parallel," explains associate producer, **Jim McDonagh**. "This helps accelerate the loading and on-the-fly decompression of *Republic's* scenes, which in turn assists the user to roam freely throughout the vast and highly detailed gaming world without noticing any slowdown."

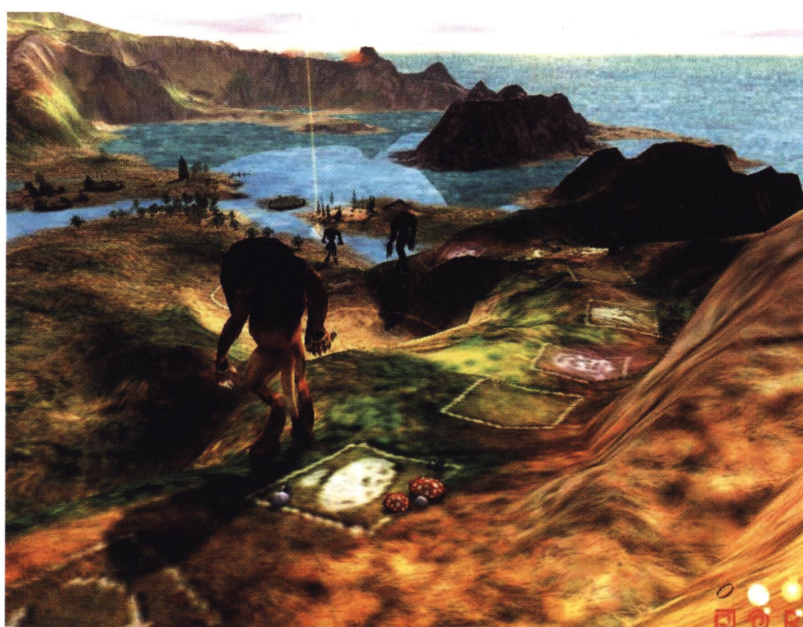
Set in the fictional eastern European country of Novistrana, the game challenges players to oust the president of the republic by any means. Five different strands of progression, either politician, businessman, criminal, religious leader or general are available. Starting with a single loyal supporter, a tiny secret HQ and a small base of local support, players must build up a nationwide faction powerful enough to oust the president and rule.

Republic creates a vast fictional city in eastern Europe without slowdown thanks to the Pentium 4 processor



*Black & White: Creature Isle

Publisher: *EA Developer: *Black & White Studios Origin: UK

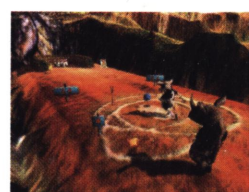
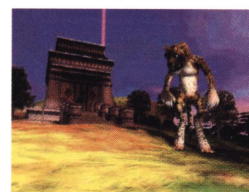


As well as being one of the landmark PC games of the past year, *Black & White* was one of the first games to be specifically optimised for the Pentium 4 processor. "Intel was very helpful when we were optimising *Black & White* for the Pentium 4 processor," explains **Jean-Claud Cottier**, Lionhead's senior 3D programmer. "From the moment we received our first Pentium 4 processor samples from Intel, we were impressed with how much faster our game ran on the new architecture." Gamers using the Pentium 4 processor gained a much smoother experience, with little level of detail popping when zooming into the landscape and much higher resolution textures.

The Intel® VTune™ Performance Analyser also proved to be extremely useful. "We had one function which converted a floating point number to an integer and we found it was taking up about ten per cent of the total processing budget using VTune," Cottier reveals. "Using a much faster function optimised by Intel for the Pentium 4 processor gave us almost a ten per cent performance gain."

This attention to detail has also been carried through to the first add-on to the game, *Creature Isle*. "The Pentium 4 processor provides higher performance, which in *Creature Isle* allowed us to add more detail to the terrain rendering," explains **Jonty Barnes**, head of *Black & White Studios, adding, "It meant we could dedicate more processor time to the complex *Creature* artificial intelligence system too."

Black & White was one of the first games to be especially optimised for the Pentium 4 processor



Intel inside gaming

*Warrior Kings

Publisher: *Microïds Developer: *Black Cactus Origin: UK



Warrior Kings is a realtime strategy game that adds a twist to the RTS mould with its role-playing storyline. Acting in a true 3D environment, players must build up an economic and military power base and research new technologies, while employing spies, mercenaries, priests and merchants to enhance their strength. Different game paths allow players to choose their style of play; from the crusading knights of the church to the destructive demons of pagans gods or the advanced technology of the renaissance scientists. Other gameplay elements include the use of real military formations and tactics applied both to open battle and siege warfare.

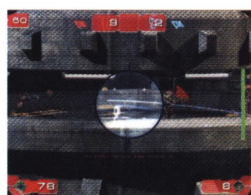
"Having direct access to Intel has been very beneficial to *Black Cactus in the development of our proprietary engine and game generation tools," says **Ian Turnbull**, director of Black Cactus. "It allows us to work through ideas with their engineers and has given us deep insights into how their systems work, while exposing Intel to cutting edge game technology and issues. It also means we can see what technologies consumers will be using several years out. Armed with this knowledge and their toolsets, we can continue to push the Pentium® processor technologies to the limit."

Black Cactus' close working relationship with Intel has enabled it to push the Pentium 4 processor to its limits



*Unreal Tournament 2003

Publisher: *Infogrames Developer: *Digital Extremes Origin: Canada

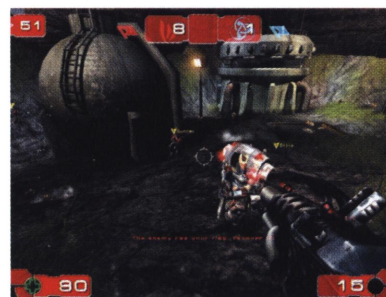


Recently, Intel has signed a major joint promotion and co-branding deal with Infogrames. "The PC platform plays a key role in the gaming market," says **Frank Heissat**, Infogrames' core games marketing director.

"Thanks to its huge penetration in households, family members of any age enjoy playing many different genres of games. And because the PC can be updated each time a technical innovation comes out, it reinforces the addictive aspect of the gaming sessions.

"Working with Intel helps us to develop better games as our development teams investigate the new possibilities offered by innovations like the Pentium 4 processor. And Infogrames helps Intel to demonstrate the capacities of their products through eagerly-awaited titles such as *Geoff Crammond's Grand Prix 4, *Unreal: Episode 2 and *Unreal Tournament 2003. As a leading company in the gaming market, Infogrames is going to keep developing the best games for the PC format with the technical input of Intel. Most of our PC titles offer multiplayer experiences too. For instance, *Neverwinter Nights allows up to 64 players to play together and create compelling, never-ending stories. Intel helps us build and provide the best gaming experience to a massive communities of fans. We will also be incorporating the Pentium 4 processors to demonstrate our PC games in the best conditions at shows such as E3."

A co-branding deal between Intel and Infogrames has taken the PC to a much wider audience of gamers



Civilisation on tour

One early benefit of the deal between Infogrames and Intel was the European 'Get Civilised' tour. Organised for *Civilisation III and held during April, it provided the opportunity for thousands of fans to meet the game's creator, Sid Meier. "Thanks to Intel's involvement, we had the chance to put on one hell of a show, and the direct involvement of Sid Meier was the icing on the cake," comments **Frank Heissat**, Infogrames' core games, marketing director. Starting in Switzerland, the eight-day marathon passed through France, Germany, Italy and Sweden, finally ending in the UK.



This is hardcore

One element of Intel expanding its brand in the hardcore gaming space has seen the company committing itself to sponsoring LAN parties and events. It is also the official processor sponsor of the Cyberathlete Professional League (CPL) in the US, which this year offers prize money of \$150,000 to the best PC game players. This deal means all PCs in the CPL are based on the Pentium® 4 processor. Intel also purchased 2,000 spectator passes, worth \$25 each, for the CPL summer championship event. They offered them on a first-come-first-served basis via the CPL Website. It provided material for the PC Modding, or PC case customisation showcase as well.

Pro gamers speak

Succubus

One of the highest ranking female gamers in the world, Cary Szeto, a Dallas-based accountant (would you believe it?) would be nowhere without her Pentium 4 processor-based PC. "It's amazing," she says. "The speed is insane. And aside from its speed, I'm very pleased with the speed of the system bus and memory too. It's nice to have a processor that can keep up with my gaming habits. I can do so many things with the Pentium 4 processor that I simply couldn't do with a slower processor."

Vicon

"With Intel Pentium 4 processors, I can play at a high and stable framerate. This means the game runs smoother and responds faster. I have never had crashes in any matches on the Internet or LAN with my Pentium 4 processor based system. It's important because we could lose a close match because of a PC crash."

deZ

"Playing games on a high performance machine increases my accuracy in aiming and decreases my reaction time. You get the best performance. The possibility of interruptions will be massively decreased because the system can handle more activities per second. A high performance microprocessor guarantees that the bottleneck, if there is any, isn't the CPU."

Sicness

"From my perspective, the CPU is way more important than the GPU. Only a good combination of a good processor and a nice video card can ensure a game runs smoothly, that's what makes the Pentium 4 processor special. It provides the best solution for CPUs, since its high quality performance is key for games."



Intel inside gaming

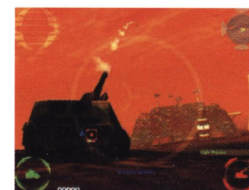
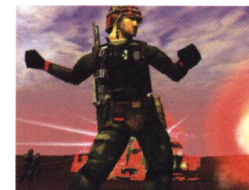
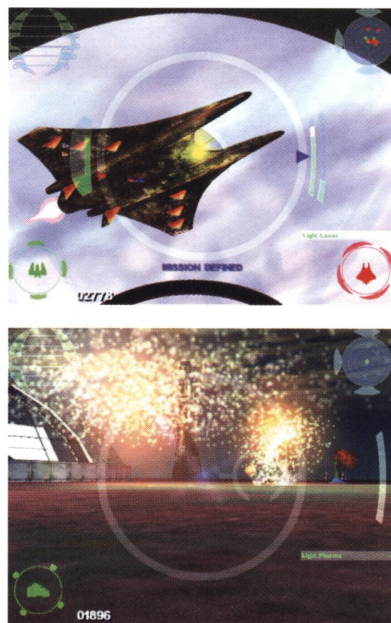
*Incoming Forces

Publisher: *Rage Developer: *In-house Origin: UK

Action, action, action is the name of the game in **Incoming Forces*. Players control a variety of different craft including gunships and tanks, interchangeable at anytime throughout the game, as they protect various alien worlds from the invading human hordes. Battles take place on four uniquely modelled planets, each with its own 3D terrain, environmental features and world-specific objects. There are various ways of playing through the game; either in the singleplayer mode or the different style offered by multiplayer gaming, including deathmatch and team deathmatch.

"*Rage is pleased to be working with Intel on *Incoming Forces*. The support Intel continues to provide with has allowed us to optimise the graphical and technical capabilities of *Incoming Forces*, while pushing the boundaries of the Intel® Pentium® 4 processor," says **John Heap**, Rage's technical director. The game boasts a state-of-the-art 3D engine, which is automatically balanced to take advantage of both a gamer's graphics card and processor. For example, the detection of a Pentium 4 processor enables specific code paths, not only to provide an increase in framerate, but subtle graphical effects such as non-uniform ambient lighting as well. *Incoming Forces* also has an advanced physics engine that allows lifelike motion of objects in realtime.

Incoming Forces' game engine enables specific code paths if a Pentium 4 processor is detected



*Counter-Strike: Condition Zero

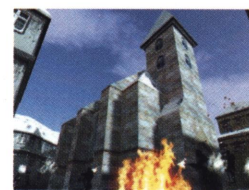
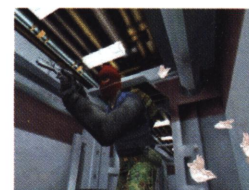
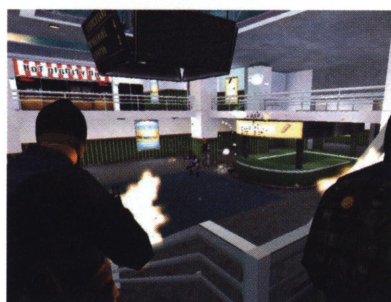
Publisher: *Vivendi Universal Developer: *Gearbox Software Origin: US

The follow-up to the million selling number one online action game, **Counter-Strike: Condition Zero* extends the *Counter-Strike* franchise with new maps, models and weapons, while simultaneously introducing new technologies. The extensive singleplayer campaign includes over 20 new missions set in a variety of fictitious conflicts zone around the globe. Players take the role of a squad leader in a counter-terrorist organisation. Missions include rescuing hostages, escorting VIPs and locating and defusing bombs. Players will be able to set up new styles of cooperative games via Internet and LAN connections.

Powered by an enhanced **Half-Life* engine, *Counter-Strike: Condition Zero* supports highly-detailed models and locale-specific skins to enable detailed squad customisation. There are over 160 character combinations in all. An arsenal of new advanced weaponry and equipment is available to teams, including upgraded firepower and bulletproof riot shields. Special and atmospheric effects, including snow and rain particle effects, are also available.

"Intel is a proven leader of gaming hardware. The innovations Intel is making with its next-generation technology, combined with the specific optimisations we have included in *Counter-Strike: Condition Zero* will make for a cutting-edge gaming experience," says **Randy Pitchford**, director of *Gearbox Software.

Counter-Strike: Condition Zero features 20 new missions and a variety of atmospherical effects



Intel inside gaming

*Karma

Publisher: n/a Developer: *MathEngine Origin: UK

Okay, *MathEngine's *Karma physics engine isn't a game but just like any other piece of game code, it has to be optimised to work at its full potential on Intel's processors. This is particularly important because physics is one area of game code that runs directly on a PC's CPU. Ensuring collision detection and other object interactions are working as smoothly as possible is a fundamental element of ensuring a game runs fast.

"Most of our customers are at the bleeding edge of games technology, pushing back the boundaries of what people believe is possible," explains MathEngine's business development manager, **Paul Topping**. "Our customers have chosen us to help them create the unbelievable and part of our response is to make our technology as optimal as possible. That means squeezing every last drop from even the most powerful Intel processors.

"Working with Intel we've taken our technology from simulating a room full of furniture a few years ago to the stunningly realistic ragdoll humans, vehicles and water effect in *Epic's *Unreal Warfare technology or *Sony Online's *PlanetSide. We've done this by designing our software to make good use of the architecture, as well as taking advantage of the sheer processing power. With an Intel processor and Karma, we can help developers make worlds that don't just look like the real thing – they feel like the real thing too."

Physics engines run directly on the CPU so the Intel Pentium 4 processor is essential for maintaining realism



*Moto Racer 3

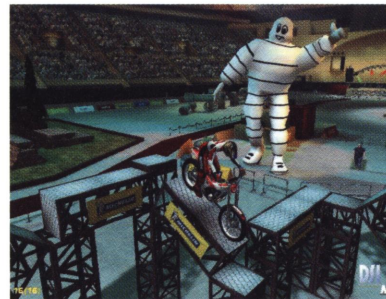
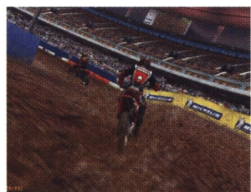
Publisher: *EA Developer: *Delphine Origin: France

Moto Racer 3 places players in a world of motor biking, which mixes realistic handling with the ease of arcade action across a range of interior and exterior race tracks and types. "Our R&D engineers worked closely with Intel in order to fully take advantage of the Pentium® 4 processor's features such as SSE2 instructions and 128bit floating point and integer data processing," says **Bertrand Gibert**, *Delphine's director of development. "We had to deal with high level of details – each of the bikes had more than 4,000 polygons for example."

Other optimisations were applied to areas such as the game's lighting, memory access and the transformation pipeline. "We managed to get a two time speed-up on the lighting process, both with and without hardware transform and lighting (T&L)," says Gibert. The memory management was improved too, by using pre-fetching instructions to make the cache management more efficient.

Another major problem was supporting graphics cards without hardware T&L capabilities. "We used many special optimisations to deal with these transformation calculations," Gibert explains. "In a game like *Moto Racer 3, where we are using so many polygons and detailed backgrounds with lots of lighting effects, it was vital to balance the performance according to the range of video boards offered on the market. This is what working with Intel helped us achieve."

Moto Racer 3 takes full advantage of the Pentium 4 processor's features to balance performance



Reign of Chaos

The highly anticipated next instalment in the *Warcraft series of realtime strategy games brings gamers back to the world of orcs and human. Using *Blizzard's proprietary 3D engine, with multiple resolutions and customisable detail quality, gamers chose to play one of four unique races, each lead by legendary heroes, which bring a new element to the RTS genre. "We're very impressed by the power of the Pentium 4 processor," says **Rob Pardo**, lead designer of Warcraft® III: Reign of Chaos™. "The processor brings out the most in today's graphics, and delivers excellent 3D quality."



Publisher: *Vivendi Universal
Developer: *Blizzard
Origin: US

Digital world

The Pentium 4 processor isn't just about games. It takes other home computing tasks such as ripping MP3 and dealing with large digital image or video files, in its stride – preferably all at the same time, while you're downloading email. The latest Pentium 4 processor offers a large performance increase over previous Intel processors when converting .wav files to MP3, for example. It also takes advantage of specifically optimised ripping software from major developers such as *Magix and *Steinberg. Users of music creation tools from *Cakewalk and *Sonic Foundry will also benefit from using a Pentium 4 processor, while video editing software including the likes of *Adobe's *Premiere or *Intervideo's *WinProducer get a massive performance boost too.

